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Forest Insect and Disease Conditions and Program Highlights

1995

MONTANA

FOREST INSECT AND DISEASE CONDITIONS AND PROGRAM HIGHLIGHTS - 1995

Report 96-2

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INTRODUCTION

This report summarizes the major forest insect and disease conditions in Montana during 1995 and was jointly prepared by Forest Health Protection, State and Private Foresty, Northern Region, USDA Forest Service and the Montana Department of Natural Resources, Division of Forestry. Information for this report was derived from ground and aerial surveys conducted across most of Montana.

SUMMARY OF CONDITIONS

Across the State, bark beetle populations have been in a general decline, although in some areas increased bark beetle outbreaks continue to occur due to ongoing outbreaks and the dry, wild fire summer of 1994. Ongoing outbreaks include the mountain pine beetle mortality to lodgepole pine in extreme western Montana, and the mortality to subalpine fir at higher elevations in southwestern Montana on the Gallatin and Beaverhead National Forests (NFs). Douglas-fir beetle and spruce beetle populations increased in fire-weakened trees in western Montana.

The summer of 1995 was the first year that no western spruce budworm defoliation was visible from the air in Montana since the annual aerial survey began in the late 1940's. Low western spruce budworm populations generally prevail across the entire western United States. No Douglas-fir tussock moth or pine tussock moth defoliation was observed in 1995. Other defoliator activity includes isolated outbreaks of western false hemlock looper near Helena, and light pine sawfly in the southeastern portion of the State on the Custer NF southeast of Ashland.

With the exception of foliage diseases, forest disease populations fluctuate very little compared to forest insect populations. Mortality and growth losses from root diseases and dwarf mistletoes continue to be high throughout the State. Root disease-caused mortality is more common west of the of the Continental Divide, though large root disease patches can be found east of the Divide.

Dwarf mistletoes continue to cause extensive growth losses and mortality across the State; losses total approximately 33 million cubic feet annually. Douglas-fir west of the Continental Divide, western larch and lodgepole pine are the tree species most severely affected.

White pine blister rust continues to be present throughout the range of 5-needle pines in the State. The rust severity is highest in the northwestern part of the State where the disease has caused extensive mortality in whitebark pine. The rust does occur in limber and whitebark pine on the eastside as well, but at this time disease incidence is relatively low and mortality is uncommon.

Foliage diseases appeared to bottom out in 1995 after 4 plus years of high incidence. The exception was Diplodia blight which continues to intensify in several major drainages in the State, especially along the lower Clark Fork River. Elytroderma needle cast continued to be severe in local areas, but was lower throughout the State when compared to previous years.

Other recent forest health conditions noted in Montana include limber pine decline south of Great Falls on the Lewis and Clark NF due to limber pine needle cast, drought related tree mortality in western Montana in all sizes of both Douglas-fir and ponderosa pine, and aspen decline in the southern part of the State on the Beaverhead, Gallatin and Custer NFs.

ANNUAL AERIAL SURVEY

The summer of 1995 was the season of weather fronts frequently flowing through the State of Montana. Much of the weather was in the form of wind and rain causing delays and shortened survey days for aerial sketch mappers. Some mountainous areas were never flown due to high winds aloft. Aerial survey flights for Montana began July 5 and ended September 6. A total of 267 hours of aircraft flight time was used to survey approximately 22.8 million acres of the State's forested lands, excluding most wilderness areas.

Both Glacier and Yellowstone National Parks (NPs) were surveyed by air in 1995. Areas not surveyed in 1995 included the Wolf Mountains on the Northern Cheyenne Indian Reservation (IR), the Blackfeet and Fort Belknap (IRs), the Rocky Mountain Division of the Lewis and Clark NF and some of the higher elevations of the Absaroka and Beartooth Mountain Ranges.

Much of the data summarized in this report is a product of the annual aerial detection survey as well as ground surveys and biological evaluations. Along with data summaries, aerial survey maps are available from the Forest Health Protection Field Office in Missoula in both paper copies and in digitized GIS format.

The annual aerial detection survey is conducted each year across most forested land in the State. The survey is conducted using a single engine, high-wing airplane flying at speeds of approximately 90 to 120 mph, at an average altitude of approximately 1,000 to 2,000 feet (AGL). Ideal weather for flying the survey is a sunny day with calm winds but due to the short time available to conduct the survey, it is flown under most weather conditions. Observed forest disturbances are sketch mapped in the form of point or polygons and attributed. Priority forest disturbances include bark beetle caused mortality, defoliators, and windthrow. If forest disturbance activity levels are low, secondary attributes such as diseases, needle damage and high-water damage are sketch mapped. This is a detection survey and, therefore, some forest disturbances are mapped and ground checked later for identification. The survey is conducted once a year during which time the observer sketch maps as many forest disturbances as possible under the above conditions.

INSECTS

Bark Beetles

Though bark beetle populations have recently been in a general decline, there were remarkable exceptions to that trend in 1995. Because 1994 had been unusually hot and dry, and warm late into the fall, bark beetle species which are especially responsive to increased host stress took advantage of that opportunity to expand their populations. Also in 1994, wild fires burned over thousands of acres in the State. Some bark beetle species, such as spruce beetle and Douglas-fir beetle, took advantage of the availability of large numbers of their fire-weakened hosts. In some areas, aggressive salvage programs may be required to prevent bark beetle populations from expanding to well beyond endemic levels. Because 1995 was a more nearly normal year, relative to precipitation, it may be that many of the increases noted in some infested areas will be short lived. Others may continue for a year or more--until weakened hosts return to more vigorous growing conditions.

The following table, and many of the subsequent summaries, reflect infested areas and mortality levels based on aerial survey estimates. A relatively small proportion have been followed by more-definitive ground surveys. Even with those limitations, the annual aerial detection survey is still an invaluable tool which enables us to more confidently detect, record, and track insect infestations. Without it, our awareness of outbreaks and impacts would be much more limited. The accompanying narrative describes bark beetle conditions, by reporting area for 1995. Where feasible and appropriate, population trends are discussed.

Table 1. Bark Beetle Infested Acres, 1994-1995

****** Montana ******		
Beetle	**1994**	**1995**
DFB	7,194	5,805
ESB	157	767
IPS	1,551	8,220
MPB	19,195	31,340
WPB	985	1,433
FE	318	349
WBBB	39,292	41,425

Note: The following abbreviations will be used throughout this report:

DF = Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopkins
ESB = Engelmann spruce beetle, *D. rufipennis* (Kirby)
IPS = Pine engraver, *Ips pini* (Say)
MPB = Mountain pine beetle, *D. ponderosae* Hopkins
WPB = Western pine beetle, *D. brevicomis* LeConte
FE = Fir engraver, *Scolytus ventralis* LeConte
WBBB = Western balsam bark beetle, *Dryocoetes confusus* Swaine
RTB = Red turpentine beetle, *D. valens* LeConte

Beaverhead NF

A few scattered groups of lodgepole pine killed by MPB were noted in the upper Wise River drainage, near Goodenough Park, on the Wise River Ranger District (RD). Many large groups of subalpine fir killed by WBBB were seen in the Tobacco Root Mountains, west of Ennis Lake; and west of the Ruby River in the vicinity of Antone Peak, on the Sheridan RD. Numerous, large groups of faded subalpine firs were again mapped in the Gravelly Range, on the Madison RD, from just south of Ennis nearly to the Montana/ Idaho border. Also on the Madison RD, other large groups of dead subalpine fir were seen near Divide Mountain, Cascade Mountain, and the West Fork Rest Area. Smaller, more scattered groups on lands administered by BLM in the Centennial Mountains along the Continental Divide. In total, on the Forest and surrounding lands of other ownerships, more than 18,300 acres have been infested by WBBB and an approximate 21,000 trees have been killed.

Bitterroot NF

On the Sula RD, ponderosa pine killed by MPB was noted along the East Fork Bitterroot River from Ross Hole into French Basin (State and private land), and eastward to Lord Creek. Also observed was widely scattered mortality attributed to DFB and IPS. Larger, 30- to 50-tree groups of beetle-killed ponderosa pine were noted east of the Bitterroot River, north of Darby, on the Darby RD. Nearly 600 trees on 150 acres have been killed.

Northward onto the Stevensville RD and adjacent private lands, widely scattered small groups of ponderosa pine killed by IPS and MPB--totaling about 50 trees on 125 acres--were observed along the eastern face of the Bitterroot Mountains. A few groups of lodgepole pine killed by MPB--less than 50 trees--were noted west of Stevensville, within the Kootenai Creek drainage. Other scattered groups of beetle-killed ponderosa pine were seen in the Sapphire Mountains, on private land east of Stevensville and on State land along Three Mile Creek.

Custer NF

Minor amounts of ponderosa pine killed by MPB were noted in North Cave Hills and Slim Buttes, on the Sioux RD. Scattered amounts of pine killed by MPB/IPS were seen in Ekalaka Hills, Chalk Buttes, and Long Pines, also on the Sioux RD. Only about 50 trees, on fewer than 200 acres were recorded.

On the Beartooth RD, small amounts of subalpine fir killed by WBBB and Douglas-fir killed by DFB were observed in the Pryor Mountains. Also on the district, groups of Douglas-fir killed by DFB were found north of Woodbine Campground, northwest of Red Lodge. Scattered mortality caused by DFB and WBBB was observed west of Red Lodge. Groups of mortality caused by DFB were noted southeast of Sheridan Campground near Mt. Maurice. Total mortality attributed to DFB was less than 250 trees on about 90 acres. Western balsam bark beetle killed an estimated 500 trees on 150 acres.

On the Ashland RD, many scattered, but small groups of ponderosa pine killed by MPB and IPS were mapped near Poker Jim Butte, Cow Creek Campground and along O'Dell Creek. Other mortality caused by MPB in small groups near Holiday Campground, northeast of Ashland. Beetle-caused mortality on the District totaled 700 trees on 250 acres.

Deerlodge NF

A small amount of lodgepole pine killed by MPB was observed near Elder Creek Campground, southwest of Boulder, Jefferson RD. Other groups were observed in lodgepole stands on the Deerlodge RD, near Sugarloaf Mountain, east of Deerlodge. Widely scattered mortality caused by MPB in lodgepole pine, and subalpine fir mortality attributed to WBBB, were

recorded west of Philipsburg, in the Sapphire Mountains, Philipsburg RD. Neither accounted for significant amounts or mortality.

Flathead NF

On the Spotted Bear/Hungry Horse RDs, MPB in lodgepole pine stands seemed to be building along the South Fork Flathead River, south and east of the ranger station. Permanent, population-monitoring plots have been established in that area, and will enable us to track that population. Douglas-fir killed by DFB was also noted in numerous groups above Spotted Bear River, northeast of Spotted Bear RD. In those infested areas, more than 550 trees have been killed on slightly more than 200 acres. Scattered lodgepole, western white, and whitebark pines killed by MPB were mapped along both sides of Hungry Horse Reservoir. Total mortality caused by MPB in those species in that area was about 350 trees on 285 acres. Also along both sides of the Reservoir, in higher elevation subalpine fir stands, WBBB has killed an estimated 200 trees on just less than 100 acres. Douglas-fir beetle has killed trees in scattered locations along the Reservoir, but becomes more noticeable northward toward, and on, Coram Experimental Forest. A few groups of spruce killed by ESB were seen near Spotted Bear and east of Desert Mountain.

On the Swan Lake RD, MPB is still active in the Crane Mountain area. Numerous groups of beetle-killed lodgepole pines--totaling nearly 8,400 trees on 1,350 acres--were once again mapped there. Many, but mostly small groups of ponderosa pine faders, killed by MPB, were observed on private land, south of the Island Unit and east of Lake Mary Ronan. Scattered mortality caused by MPB in lodgepole pine, was noted throughout the Island Unit, itself. In the southern portion of the district, into the Swan Valley, scattered MPB in western white pine, as well as damage caused by DFB and WBBB was observed along and south of Swan Lake. The same scattered pattern of mortality, and occasionally including MPB in lodgepole pine, were noted south to Holland Lake and around Lindbergh Lake. None were considered significant epidemics.

On the Tally Lake RD, little remains of the once expansive MPB outbreak. Some scattered trees killed by DFB and WBBB were located throughout the RD, with higher concentrations around Tally Lake. A potentially explosive ESB population has been found in down and weakened Engelmann spruce, in stands affected by the Little Wolf Fire, southwest of Whitefish. Salvage of that infested material is being planned.

The Glacier View RD experienced scattered mortality caused by WBBB at higher elevations throughout the district. Mountain pine beetle populations in western white pine were observed in Big Creek, Coal Creek, and Canyon Creek drainages, but totaled only about a tree per acre over 30 acres. On the adjacent Stillwater SF, MPB is also killing western white pine north of Whitefish Lake--and scattered to Upper Whitefish Lake. Elsewhere, minor amounts of beetle-killed white pine were found. Total infested acres of western white pine on State and private land in the reporting area was 130 acres, on which 200 trees were killed.

Gallatin NF

Many large groups of subalpine fir killed by WBBB were observed throughout the Gallatin Canyon, Bozeman RD, in both the Madison and Gallatin Mountain Ranges. Heaviest concentrations were seen in the Taylor Creek drainage, northwest of Yellowstone NP. Heavy concentrations of beetle-killed subalpine fir were also found around Hebgen Lake, Hebgen Lake RD, and in Hyalite Canyon, Bozeman RD. Total mortality caused by WBBB on the Forest covered more than 20,000 acres. An estimated 18,000 trees were killed. Scattered mortality caused by DFB, totaling only about 40 acres, was located in the Big Creek drainage, Bozeman RD.

Several groups of Douglas-fir killed by DFB were seen northwest of Gardiner, and in Heron and Cinnabar Creek drainages, Gardiner RD. About 100 trees were killed on 25 acres. Elsewhere on the District, subalpine firs killed by WBBB were noted near Jardine and Cooke City. Nearly 1,400 trees have been killed on just over 800 acres. Engelmann spruce infestations were still found in the vicinity of Cooke City--west along Soda Butte Creek, and to the east, south of Colter Pass. On both Federal and private land in that area, about a tree per acre has been killed on slightly more than 200 acres.

On the Big Timber RD, a few groups of lodgepole pine killed by IPS--totaling about 40 acres--were seen in the eastern part of the Crazy Mountains, north of Big Timber.

The Boulder River corridor, on the District, was not flown due to high winds.

Little is left of the DFB outbreak in the Mill Creek drainage, Livingston RD; however, populations were still observed in the Sixmile drainage and near Pine Creek Campground. Douglas-fir beetle was observed on about 100 acres throughout the district in 1995.

Helena NF

On the Townsend RD, numerous small groups of lodgepole pine killed by MPB were mapped in the vicinity of Confederate Gulch, in the Big Belt Mountains. Other, minor amounts of beetle-killed lodgepole--some likely associated with winter-damaged trees--were recorded in the southern portion of the Big Belts. In total, lodgepole killed by MPB totaled approximately 350 trees on 211 acres. In that same area, but at higher elevations, subalpine fir killed by WBBB can be found. Similar, scattered groups of subalpine fir have been killed in the Elkhorn Mountains. Total for the district was 92 trees on about 600 acres.

Lands of mixed ownership, within the Helena RD reporting area, supported ponderosa pine stands in which MPB have killed trees in the West Elkhorns, Grizzly Gulch, Orofino Gulch, and Dry Gulch--all south of Helena. Scattered, small groups of ponderosa pine, killed by MPB, were reported east of Hauser Lake, in the northern Big Belts. About 400 acres are infested, and approximately a tree per acre has been killed. Many small, scattered groups of MPB-infested lodgepole pine--amounting to about 200 trees on 150 acres--were mapped west of Helena, along the Continental Divide.

On the Lincoln RD, there were still numerous groups of trees killed by DFB, but the infestation was down markedly from a few years ago. Most of the remaining infested stands were west of Lincoln, south of Highway 200, and east of the Nevada/Ogden Road--though an infestation was still active near Mitchell Mountain, on privately owned land. Less than 200 acres remained infested. Elsewhere on the District, many groups of subalpine fir killed by WBBB and small, scattered groups of MPB-killed lodgepole pine were mapped north of Lincoln, near Stonewall Mountain. Subalpine fir infested by WBBB were noted in upper Copper Creek. Western balsam bark beetle was recorded as the cause of death for 220 trees on 170 acres on the district. Small, dispersed groups of ponderosa pine killed by MPB were recorded east of Rogers Pass and on private land east of Sunset Mountain.

Kootenai NF

On the Three Rivers (Yaak) RD, scattered mortality caused by MPB in lodgepole pine stands were observed in the lower Yaak River drainage. An active population was evaluated in the vicinity of Newton Mountain and found to be building over last year's level. Mountain pine beetle was also affecting western white pine throughout the drainage, much of it in association with blister rust. Particularly high amounts were located in the Red Top Creek and Hellroaring Creek drainages. Other, larger groups of MPB in LPP were observed in Pete Creek, near Garver Mountain. Elsewhere, MPB populations were widely scattered. Mountain pine beetle was attributed with mortality of 1,200 lodgepole pines, on 800 acres; and 130 white pines on 107 acres, throughout the district. In addition, about 50 subalpine fir killed by WBBB were noted on 25 acres in the upper reaches of Hellroaring Creek.

On the Three Rivers (Troy) RD, there was widely dispersed mortality caused by MPB in lodgepole and western white pine throughout. More concentrated groups of white pine mortality was located in the Callahan Creek drainage. Small groups of Douglas-fir, killed by DFB were found north of the Kootenai River, from Kootenai Falls to O'Brien Creek. Other groups of

mortality caused by DFB were concentrated north of Bull Lake. On the District, about 640 Douglas-fir have been killed on 185 acres.

The combined Fisher River/Libby RD, showed small groups of lodgepole pine killed by MPB scattered south of Libby, and north into the Purcell Mountains. Numerous, but small groups were seen in Cherry Creek and Blue Baron Creek. Scattered mortality occurred in low-elevation ponderosa pine stands, killed by both MPB and WPB. More numerous groups were mapped in the Pleasant Valley area. On the combined Districts, MPB killed approximately 1,600 lodgepole and 200 ponderosa pines, on 600 and 100 acres, respectively. Another 30 ponderosa pines, on 50 acres, were killed by WPB. About 30 dead subalpine fir, scattered over 50 acres, and attributed to WBBB, were recorded near Meadow Peak.

In the upper Dodge Creek, Young Creek, and Big Creek drainages, on the Rexford RD, scattered groups of lodgepole pine killed by MPB were reported. More than 2,500 lodgepole pines were killed, on 655 acres, throughout the District in 1995. Concentrations of subalpine fir killed by WBBB were noted near Temple Falls--a part of the nearly 300 trees killed on the District. Minor amounts of trees affected by DFB and WBBB were seen south and west of Eureka. The District was adversely affected by an abnormal number of forest fires in 1994 and are working to prevent population buildups of DFB and ESB in fire-weakened hosts.

On the Fortine RD, in the Grave Creek drainage, many scattered groups of trees affected by bark beetles were observed. Lodgepole pine and western white pine killed by MPB, Douglas-fir attacked by DFB, and subalpine fir impacted by WBBB are common from Murphy Lake to the Canada/US border. Total mortality is not significant, but it is noticeable.

Lewis & Clark NF

Scattered groups of lodgepole pine, killed by MPB, were observed in the Highwood Mountains, and also near Anderson Peak and along Dry Fork Belt Creek on the Judith RD. Some of that mortality appeared to be associated with winter-damaged trees.

Small groups of ponderosa pine killed by MPB were noted on the Musselshell RD in the Blacktail Hills and the vicinity of Bair Reservoir. Also on the Musselshell RD, minor amounts of subalpine fir, affected by WBBB, were mapped in the northern Crazy Mountains. Additional beetle-caused mortality on the District included scattered groups of ponderosa pine, killed by IPS and MPB in the Little Snowy Mountains, southeast of Lewistown and the Big Snowies, south of there. Forest-wide, beetle-caused mortality in ponderosa pine stands, on lands of all ownerships, totaled slightly more than 1,000 trees on just under 900 acres.

Subalpine fir mortality, attributed to WBBB, was also noted in the Little Belt Mountains, Kings Hill RD. There, it amounted to 190 trees on 140 acres. Small groups of LPP killed by MPB were scattered on the District, as well. On lands administered by BLM, north and east of Lewistown, numerous groups of ponderosa pine, attacked by MPB, were mapped in the North Moccasin and Judith Mountains.

Lolo NF

On the Ninemile RD, scattered, dead ponderosa pine, killed by MPB were mapped throughout the lower Ninemile Creek drainage. A stand of second-growth ponderosa pine, near Blue Ridge, has supported an active MPB population for several years. In the upper portion of the drainage, in the vicinity of Siegel Pass, MPB in lodgepole pine was common. In the upper reaches of Mill Creek, there remain several groups of lodgepole pine which have been infested by MPB.

Along the Clark Fork River, ponderosa pine killed by a complex of beetles including IPS, WPB, MPB, and RTB, first became noticeable in late fall, 1994. More than on just the Ninemile RD, ponderosa pines on those dry sites along the Clark Fork extended from east of Drummond, westward to west of Thompson Falls. In the Fish Creek and Petty Creek drainages, scattered ponderosa pine killed by MPB was observed at lower elevations; and at higher elevations, lodgepole pine killed by MPB and western white pine was more noticeable. A small amount of beetle-killed whitebark pine was seen, but was widely scattered. In total, District-wide mortality, attributable to bark beetles

(including the Clark Fork survey, flown late in 1994) was: MPB--630 acres, 390 lodgepole and 1,600 ponderosa pines; WPB--65 acres, 40 ponderosa pines; and a complex of MPB, WPB, RTB, and IPS--3,500 ponderosas on 1,300 acres. Occasional Douglas-fir killed by DFB were noted, and in higher, subalpine fir stands, trees killed by WBBB were more numerous. Neither represented serious outbreaks.

Within the Missoula RD, numerous scattered groups of ponderosa pine killed by IPS, plus ponderosa pines infested by MPB and WPB, were observed. In higher-elevation lodgepole pine stands, widely scattered mortality caused by MPB occurred. In the upper portion of Lolo Creek, small amounts of WBBB-killed subalpine fir were noted. Dead ponderosa pines, along the Clark Fork corridor, which were killed by the IPS/MPB/WPB/RTB complex, were scattered along I-90 to the east, to Rock Creek. Some similar mortality occurred within the Rock Creek drainage, itself. Within the Rock Creek drainage, in the Welcome Creek Wilderness, a few small groups of Douglas-fir killed by DFB were noted. To the northeast of Missoula, in the lower Rattlesnake drainage, ponderosa pines killed by IPS and WPB were observed. Beetle-caused mortality on the District totaled 90 ponderosa and 150 lodgepole pines killed by MPB, on a combined 180 acres; 320 ponderosa pines killed by WPB on 135 acres; almost 770 ponderosa pine, on 300 acres, killed by IPS; and but 50 subalpine firs killed by WBBB, on 35 acres.

Lodgepole pine infected by MPB increased several fold along the Mineral/Sanders County divide between Plains and St. Regis, on the Plains/Thompson Falls RD, and remained the most actively infested area in the Region. The largest infested groups, within the Coeur d'Alene Mountains, number from 2,000 to 4,000 dead trees and are found in upper Tamarack Creek and Flat Rock Creek. Other larger groups were seen northwest of Combest Peak. Ground surveys conducted in that area showed still-building populations and a range of from 15 to 64 new attacks per acre, for the areas surveyed. Numerous, but smaller groups were noted east of Plains, along the divide between the Forest and Flathead IR, and in the Little Thompson River drainage--mostly within the McGinnis and Corona Creek drainages. Elsewhere, MPB was found to have infested lodgepole and ponderosa pines in a widely scattered pattern, throughout the district. Small groups of LPP infested by MPB seemed to be developing in the Prospect Creek drainage and one of its tributaries, Clear Creek. In total, the infested area on the Plains/Thompson Falls RD and Superior RD (and adjacent State and private land) covers more than 12,500 acres. An estimated 37,700 trees were killed in 1994 (mapped in 1995). Stands along the Clark Fork corridor showed significant mortality, as previously described.

On the Seeley Lake RD, several small groups of subalpine fir killed by WBBB were mapped above Lake Marshall and Alva Lake. Late-summer windthrow, near Colt Lake and Summit Lake, was salvaged in order to prevent future mortality caused by ESB. Groups of dead subalpine fir, attributed to WBBB, were found near Matt Mountain and Morrell Mountain. Those were the most significant bark beetle outbreaks on the district, and totaled 100 trees killed on about 70 acres. Scattered ponderosa pine killed by was noted in the lower Clearwater River drainage, near Harpers Lake; within the Monture Creek drainage; and near the Blackfoot Clearwater Game Range. Minor amounts of Douglas-fir killed by DFB and whitebark pine killed by MPB are scattered throughout the respective type.

Garnet Mountains (BLM)

Many, small groups of ponderosa pine, killed by either IPS, MPB, or WPB, were recorded east of Bonner; along the Blackfoot River in the vicinity of Potomac; and near Clearwater Junction. Other, similar groups were found along I-90, in the southern part of the reporting area, from Missoula to Rattler Gulch. Much less numerous groups were observed east to Garrison Junction. In the reporting area, slightly more than 1,900 trees were killed on an approximate 1,100 acres.

Flathead IR

Though no large groups were recorded, many small groups of ponderosa pines were killed by MPB or IPS throughout the Reservation. Lodgepole pine, killed by MPB took on the same, scattered pattern. Many groups of ponderosa pines killed by MPB were found within the northern portion of the Reservation, from Flathead Lake, westward to the Reservation boundary. Scattered dead ponderosa pine, killed by WPB, MPB, or both, were mapped along the western edge of the Reservation, south to Rainbow Lake. South and west of Hot Springs, numerous small groups of lodgepole pine killed by MPB were observed. Along the eastern portion of the Reservation--in the foothills of the Mission Mountains, south to Evaro--ponderosa pine stands contained widely dispersed trees killed by MPB and IPS. Throughout the Reservation, more than 3,500 acres showed some level of bark beetle mortality. An estimated 3,500 ponderosa pines were killed by IPS, and another 2,300 by MPB. An additional 1,700 lodgepole pines were killed by MPB. Ground surveys conducted in a few selected lodgepole pines stands, near Rainbow Lake, showed an average of about 12 new attacks per acre.

Crow IR

The only portion of the Reservation flown in 1995 was that part within the Pryor Mountains. There, only a few scattered ponderosa pines, killed by MPB; and subalpine firs, killed by WBBB, were observed. Nearly insignificant numbers of beetle-killed trees were recorded.

Northern Cheyenne IR

More scattered ponderosa pine mortality, caused by MPB, was observed in 1995 than had been in more recent years. Numerous small groups were observed from Dry Creek, north to Busby Creek--southeast of Busby. Other groups were found scattered south of Lame Deer. Some of the mortality was apparently caused by IPS, but those infestations seem to be fewer than in the recent past. Throughout the Reservation, about 1,900 trees were killed on 240 acres.

Rocky Boy's IR

Ponderosa and lodgepole pine stands infested by both IPS and MPB were reported in several locations on the Reservation. IPS and MPB were found in ponderosa pine stands along Sandy Creek and Muddy Creek, near Centennial Mountain. A total of 42 trees were killed on 18 acres. An estimated 530 IPS-killed ponderosa pines were noted on 140 acres across the Reservation. Most notable of the outbreaks was one near Sawmill Butte. IPS-infested lodgepole pine stands were recorded on about 25 acres south of Moses Mountain. Active MPB populations were seen in lodgepole pine stands west of Black Mountain. A few, small groups of beetle-killed trees were noted elsewhere on the Reservation. Approximately 200 trees were killed on about 40 acres, total.

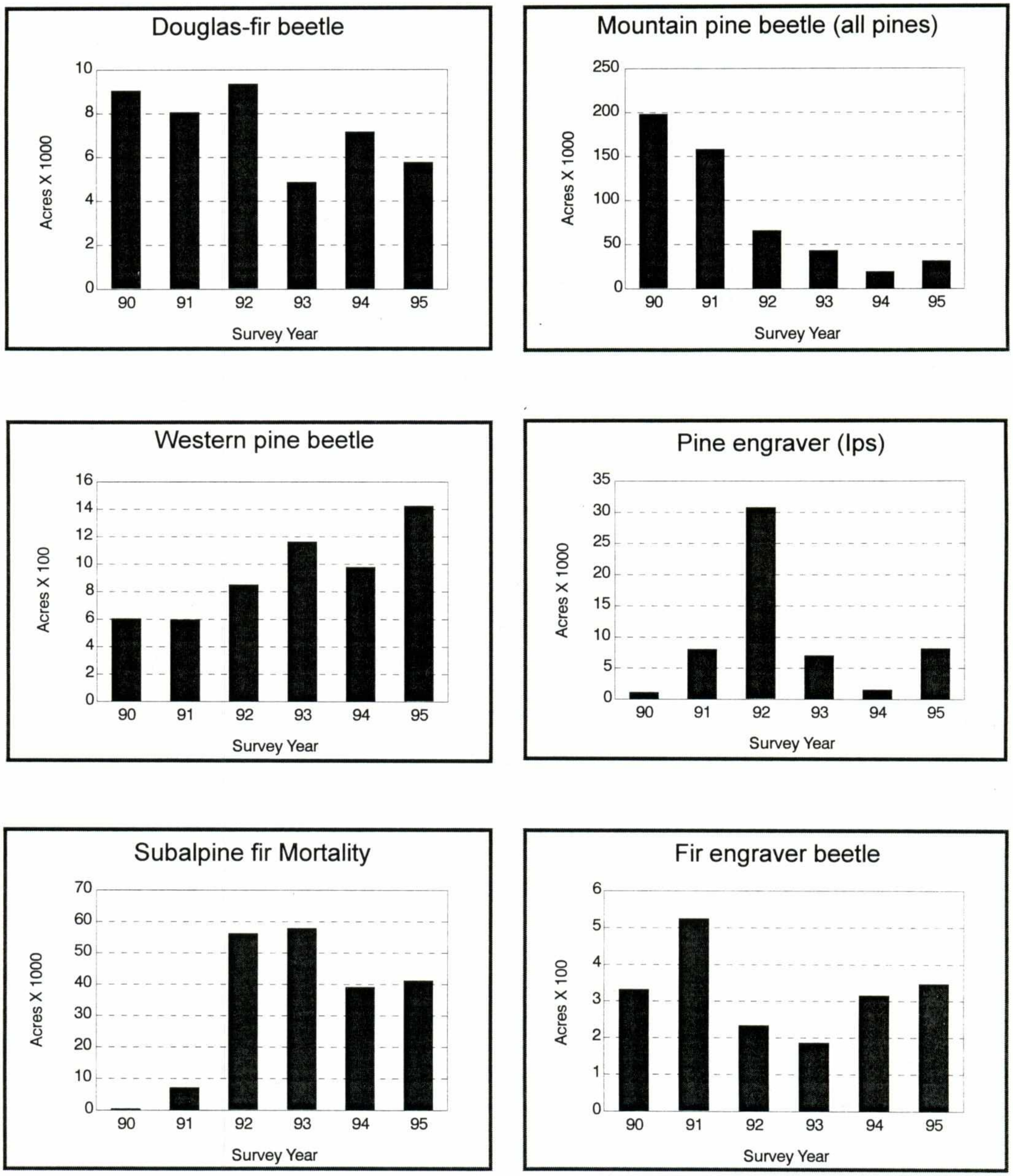
Glacier NP

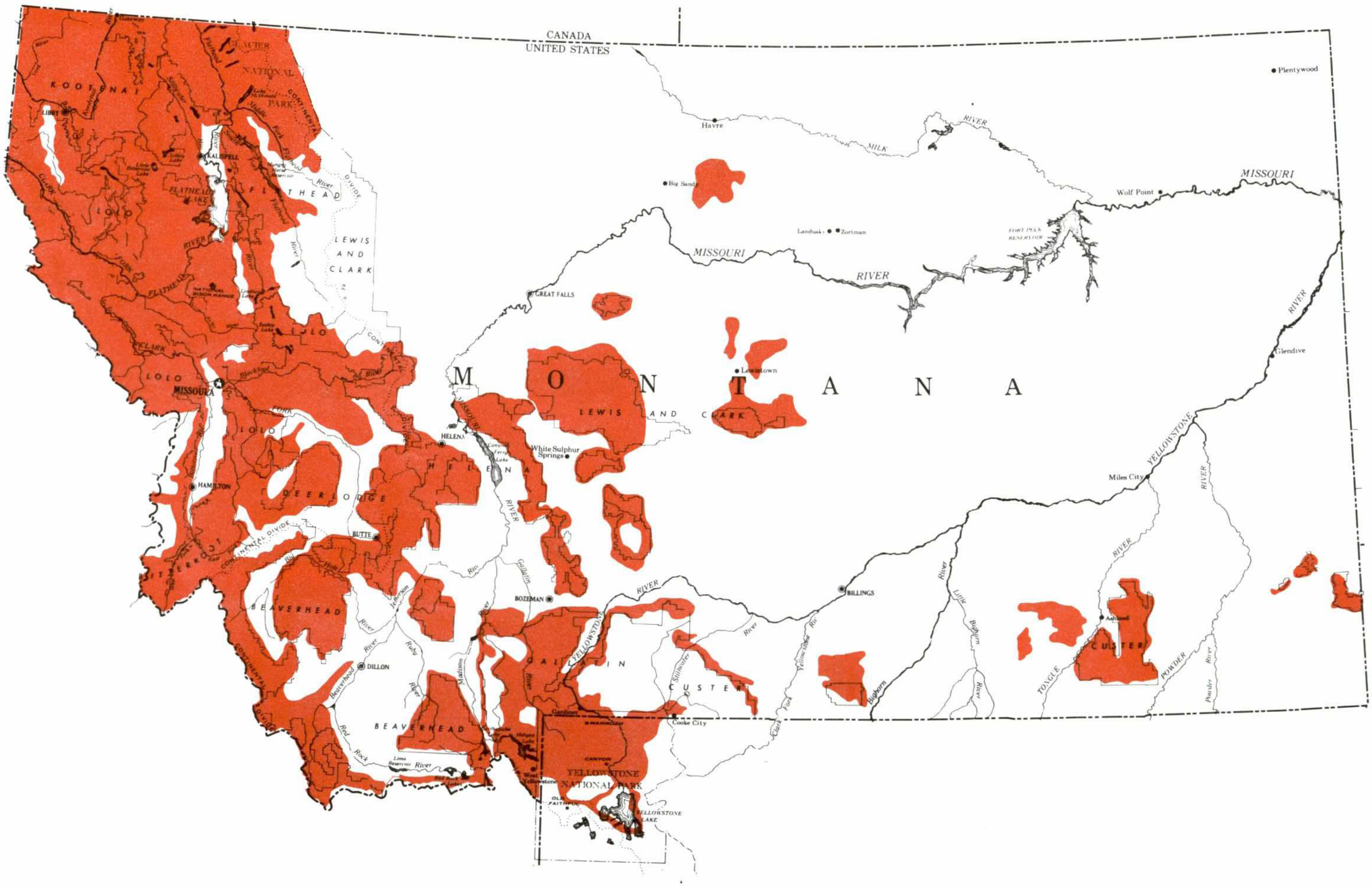
Though but a small remnant of the wide-spread MPB infestations of a decade ago, small and scattered groups of beetle-killed lodgepole and western white pine were found in various locations within the park. Most lodgepole pine killed by MPB was widely scattered--totaling only about 100 trees on 55 acres. While the majority of the white pine which has been beetle killed was found along the South Fork Flathead River from Nyack Ranger Station (RS) to Walton RS, numerous groups were mapped south of McDonald Lake. Park totals were 250 trees killed on 540 acres. Significant outbreaks of ESB and DFB are found in low-elevation or wetter stands in drainage bottoms and along lake shores. Numerous groups of Douglas-fir killed by DFB were noted just north of Kintla Lake, near Logging Lake, on the south shore of McDonald Lake, and in the upper Nyack Creek drainage. more than 1,300 acres are infested, and an estimated 1,800 Douglas-firs have been killed. Engelmann spruce beetle populations have built along Bowman Lake, and within the Nyack Creek and Park Creek drainages, and have killed 600 trees on 300 acres. Subalpine fir, killed by WBBB, was mapped in higher elevation stands near Waterton Lake and near McDonald Creek. Nearly 400 trees were reported killed on 250 acres.

Yellowstone NP

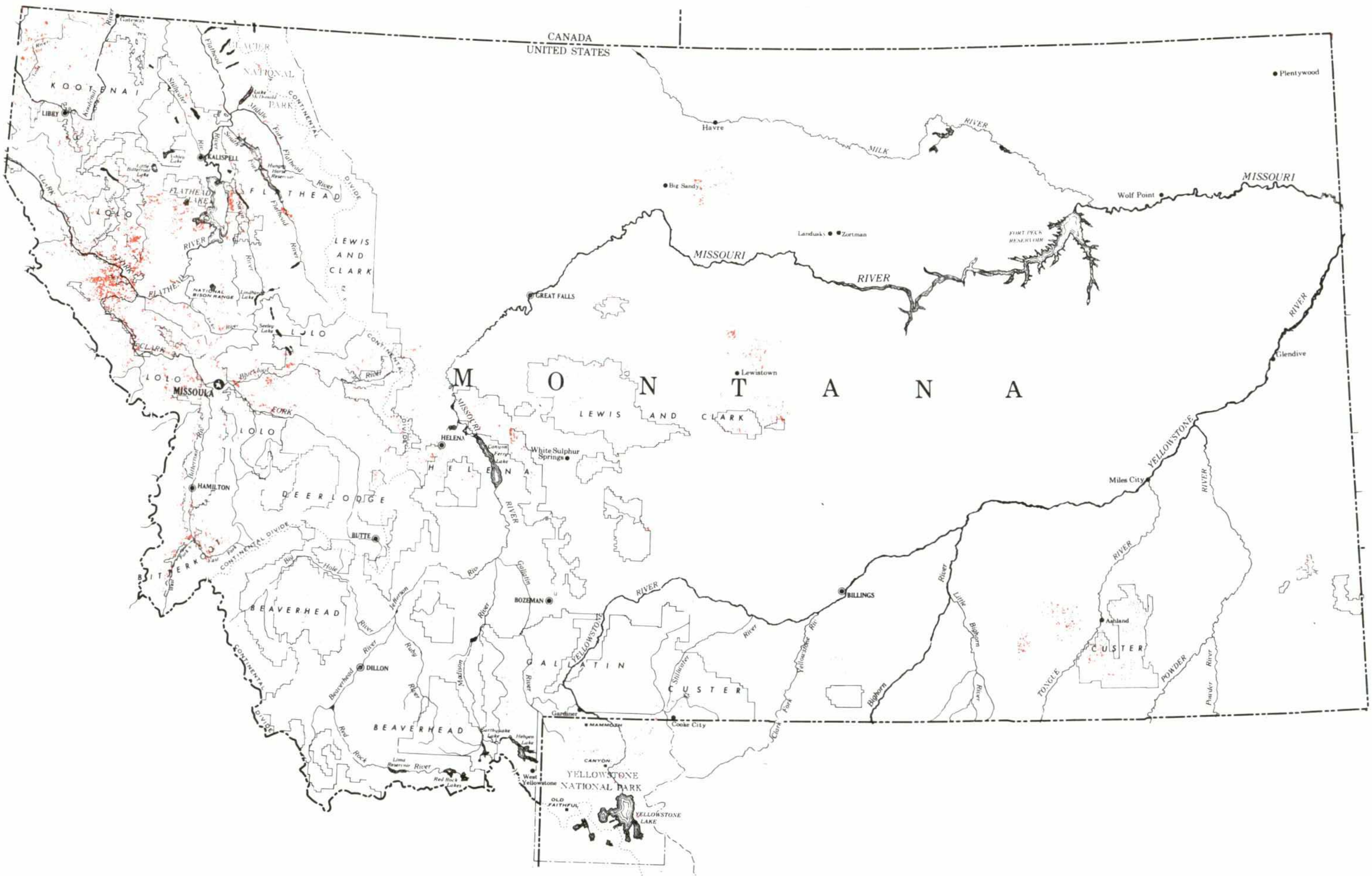
Many large groups of subalpine fir, killed by WBBB, were found in the northern one-third of the Park--especially from Mount Holmes, northward to the Park boundary, and along Grayling Creek, just outside the northwest corner of the Park. Many, but smaller groups of DFB-killed Douglas-fir were mapped from just west of Gardiner to Cooke City, also within the northern portion of the Park. ESB-infested spruce was found along Slough Creek and from there eastward towards Cooke City. A mix of ESB, DFB and WBBB infestations, in their respective hosts, were observed from Lamar RS to the Northeast Entrance. Subalpine fir stands infested by WBBB were noticeable around Canyon Village. Widely scattered lodgepole pine mortality, caused by MPB and IPS, was less evident. A few large groups of mortality caused by WBBB were found east of Southeast Arm of Yellowstone Lake. Most of the southwestern portion of the Park was not flown in 1995. In total, tree mortality, attributable to bark beetles was as follows: WBBB--820 trees on 435 acres; DFB--880 trees on 550 acres; ESB--300 trees on 160 acres, and MPB--20 trees on but 15 acres.

Figure 1. Bark beetle infestation acres and subalpine fir mortality recorded during aerial surveys, 1990 - 1995.





Areas of coverage during the 1995 Aerial Detection Survey in Montana.



Areas of pine beetle (mountain, western and Ips) infestations in Montana (all host species), 1995.

Areas of subalpine fir mortality caused by western balsam bark beetle and other agents in Montana, 1995.

Table 2. Douglas-fir beetle-infested acres in Montana, all ownerships, from 1993 through 1995.

	1993			1994			1995		
Reporting Area	Acres	Trees	Vol. (MBF)	Acres	Trees	Vol. (MBF)	Acres	Trees	Vol 1. (MBF)
Beaverhead NF	311	190	38.0	47	51	10.2	6	8	1.6
Bitterroot NF	201	467	140.1	166	351	105.3	64	121	36.3
Custer NF	562	711	45.2	672	793	158.6	102	256	51.2
Deerlodge NF	12	15	3.0	32	32	6.4	19	21	4.2
Flathead NF	510	907	272.1	1,629	3,869	1,160.7	746	1,823	546.9
Gallatin NF	1,034	1,182	871.0	1,182	1,164	232.8	224	502	100.4
Helena NF	503	1,104	220.8	996	1,354	270.8	1,4217	1,082	216.4
Kootenai NF	589	1,155	346.5	1,272	2,547	764.1	554	1,434	430.2
Lewis & Clark NF	46	67	108.8	14	20	4.0	94	35	7.0
Lolo NF	606	1,051	315.3	624	1,221	366.3	455	622	186.6
Swan River SF	16	53	15,9	145	362	111.6	7	13	3.9
Stillwater SF				10	9	2.7	4	4	1.2
Thompson River SF	0	0	0	28	78	23.4	0	0	0
Flathead IR	156	295	88.5	166	438	131.4	95	156	46.8
Garnets	44	92	27.6	123	201	60.3	79	116	34.8
Crow IR	29	63	12.6	*	*	*	8	10	2.0
Glacier NP	214	483	144.9	*	*	*	1,371	1,877	563.1
Yellowstone NP	114	235	47.0	*	*	*	549	880	176.0
Other Areas	2	5	1.0	88	103	20.6	--	--	
Total	**5,288**	**8,856**	**2,065.3**	**7,194**	**12,603**	**3,429.2**	**5,805**	**8,960**	**2,408.6**

*Not flown
**MBF = 1,000 board feet

Table 3. Acres of mountain pine beetle caused mortality on state and private lands in Montana from 1993 through 1995

	1993				1994				1995			
Area	LPP[1]	PP	WBP	WWP	LPP	PP	WBP	WWP	LPP	PP	WBP	WWP
Beaverhead NF	35	0	--	0	9	0	0	0	15	2	--	--
Bitterroot NF	8	306	--	0	0	269	0	0	14	428	--	--
Custer NF	4	19	--	0	0	2	0	0	2	42	--	--
Deerlodge NF	122	12	--	0	99	33	2	0	25	21	--	--
Flathead NF	190	504	0	573	191	36	0	49	195	461	2	130
Gallatin NF	485	0	4	0	49	0	32	0	2	--	17	--
Helena NF	100	306	2	0	34	132	2	0	143	290	15	--
Kootenai NF	75	19	--	60	53	20	0	70	416	109	--	60
Lewis & Clark NF	26	12	--	0	2	337	0	0	11	389	--	--
Lolo NF	253	504	--	2	463	508	0	2	1,931	1,114	7	--
Stillwater SF	6	10	--	358	4	2	0	59	81	2	--	210
Swan River SF	56	186	--	8	0	2	0	14	2	--	--	--
Thompson R. SF	163	70	--	0	618	137	0	0	--	--	--	--
Garnets	40	294	--	0	6	174	0	0	17	374	--	--
Other		548			57	26	0	120	42	338	--	--
Total	**2,726**	**1,994**	**6**	**1,001**	**1,575**	**1,678**	**36**	**314**	**2,896**	**3,570**	**41**	**400**

[1]LPP = lodgepole pine; PP = ponderosa pine; WBP = whitebark pine; WWP = western white pine

Table 4. Bark beetle infested acres (other than mountain pine beetle and Douglas-fir beetle) in Montana, all ownerships.

	Engelmann Spruce Beetle			Pine Engraver Beetle			Western Pine Beetle			Fir Engraver Beetle			Western Balsam Bark Beetle**		
Reporting Area	1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995	1993	1994	1995
Beaverhead NF	7	0	--	0	57	0	6	--	--	0	0	--	22,543	17,447	18,381
Bitterroot NF	0	0	2	0	0	156	144	196	212	0	2	14	10	42	42
Custer NF	0	14	--	2,169	0	49	0	--	--	0	0	--	70	369	166
Deerlodge NF	2	0	11	0	0	14	2	0	17	0	6	--	242	177	32
Flathead NF	20	40	72	0	0	36	42	32	92	20	58	59	173	194	392
Gallatin NF	0	138	204	27,936	831	112	12	--	--	24	0	--	32,454	19,749	20,088
Helena NF	29	8	22	0	0	35	126	--	--	0	0	--	254	183	844
Kootenai NF	4	0	--	0	2	34	2	56	181	26	38	65	38	56	297
Lewis & Clark NF	109	41	11	871	185	637	76	--	--	96	150	192	553	842	235
Lolo NF	4	6	11	0	57	2,896	0	417	2,016*	0	0	0	174	206	207
Garnets	0	0	--	0	0	549	50	0	137	0	0	17	27	4	8
Flathead IR	0	2	--	2	0	1,983	88	176	102	22	0	--	24	20	34
No. Cheyenne IR	*	*	4	*	*	231	*	*	--	*	36	0	*	*	0
Stillwater SF	0	0	4	0	0	0	0	1200	0	0		2	10	0	23
Swan River SF	0	0	0	0	0	0	0		2	0		0	0	0	0
Thompson River SF	2	0	0	0	0	0	12	0	0	0	4	0	22	2	0

*Not flown

**Mortality in subalpine fir

DEFOLIATORS

Western Spruce Budworm

Western spruce budworm populations remained very low in Montana in 1995. No defoliation was detected from aerial surveys. Very light defoliation was recorded on spruce budworm permanent plots on the Helena and Beaverhead NFs. Fourteen male moths were caught in pheromone traps on permanent plots in the Gates of the Mountain Wilderness on the Helena NF. Spruce budworm populations are expected to slowly build up over the next several years. The population increase will depend largely on climatic conditions and other factors.

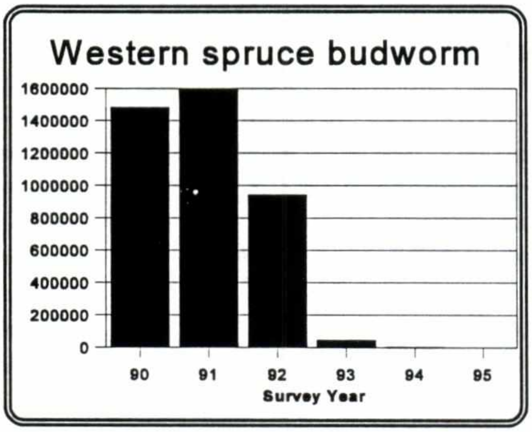


Figure 2. Acres of defoliation recorded during aerial surveys.

Douglas-fir Tussock Moth

Douglas-fir tussock moth populations continue to be very low in Montana as well as in most western states. No defoliation was detected from aerial survyes or from ground surveys in 1995. For the first time since annual pheromone trapping of adult males began, zero moths were caught.

Gypsy Moth

For the second year in a row no gypsy moths (*Lymantria dispar*) were caught in the detection traps placed throughout the State of Montana. Over 1,300 detection traps were placed by USDA Forest Service, Animal and Plant Health Inspection Service (APHIS), Montana Department of Agriculture, and the Montana , Department of State Lands. There was a report of a suspicious moth sighting from Eureka, Montana which APHIS will investigate in 1996.Moths were trapped in neighboring states. Wyoming reported six moths (two in Yellowstone NP), South Dakota caught eight moths (four in the Black Hills), and Idaho caught one. Asian gypsy moths were again detected in the State of Washington. As neighboring states continue to detect gypsy moths and Asian/ European hybrids are introduced to the Region, the importance of detection trapping increases. Thanks to those who participate in this annual program, we are able to assess the threat that the Asian and European gypsy moths pose to Montana's natural resources.

Pine Tussock Moth

The pine tussock moth (*Dasychira grisefacta* (Dyer)) population on the Sioux RD of the Custer NF collapsed in 1995. No defoliation was detected in the aerial survey and District personnel were unable to find any larvae in the stands defoliated in 1994. No mortality from this insect is expected.

Since the population has apparently crashed, the six plots established in 1994 to follow pine tussock moth activity were not remeasured.

Pine Sawflies

Stand exam crews on the Ashland RD of the Custer NF detected a population of pine sawflies between Tenmile and Fifteenmile Creeks. Pine sawfly populations were last detected on the district in 1992 around Lyon Creek, south of Fifteenmile Creek.

Western False Hemlock Looper

Three areas near Helena were defoliated by the western false hemlock looper. The defoliation closely resembles that of Douglas-fir tussock moth or western spruce budworm. Two polygons, totalling 54 acres, were aerially detected approximately 17 miles NE of Helena. A third area of 39 acres was found just south of the Town of Winston. Ground checking found that defoliation ranged from light to heavy. Some mortality may occur in pole-sized trees that were heavily defoliated.

In 1973 on the Flathead NF, approximately 3,000 acres were defoliated by the western false hemlock looper. In 1974, only 1,760 acres were defoliated. No defoliation has been detected until 1995.

OTHER INSECTS

Pine Root Collar Weevil

In 1995, pine root collar weevil larvae and adults were found in young lodgepole pines in test plantations on the Beaverhead, Deerlodge and Lewis and Clark NFs. A significant amount of mortality from the pine root collar weevil was found in a naturally regenerated young lodgepole pine stand near the Wet Park test plantation. We also found a few trees dying from pine root collar weevil in other young lodgepole pine stands on the Lewis and Clark NF.

The pine root collar weevil is usually considered a secondary insect that attacks trees weakened by other factors. The trees in the plantation that showed the heavy mortality had severe hail damage. There may also have been root rot and staining fungus killing the trees in the plantation which is often vectored by root collar weevils.

We suspect that the species is *Hylobious warren* Wood, the Warrens' collar weevil. The Warren's collar weevil attacks pines throughout Canada and western states bordering Canada. It is the most prevalent and damaging weevil to young pines causing growth loss and mortality by girdling at the base of trees and also providing infection avenues to root rots and staining fungus. Trees from 6 to 8 years old through maturity can be attacked and killed.

DISEASES

Foliage Diseases

Spring/summer of 1995 came with the reappearance of needle diseases throughout western Montana. Outbreaks of needle diseases are brought about and perpetuated by cool, wet periods during late spring and early summer. Symptoms of reddening foliage appear on last year's needles during this same time period.

Lodgepole pine needlecast (*Lophodermella concolor*) was not nearly as severe as in the past few years. Larch needle cast (*Meria laricis*) and larch needle blight (*Hypodermella laricis*) have been chronic for many years with occasional "hot" years; 1995 was not a "hot" year. The needle diseases that seem to be on an upswing are Elytroderma needle cast (*Elytroderma deformans*) and Diplodia tip blight (*Diplodia pinea*), both in ponderosa pine. These two diseases seem to be more widespread every year. The hardest hit areas have been the lower Clark Fork drainage, the Bitterroot drainage, and the western shore of Flathead Lake. Steve Kohler, Montana State entomologist, recalls a similar "outbreak" of Elytroderma needle cast along the western edge of Flathead Lake back in the early 1970's. The outbreak subsided after a few years and the trees appeared to recover. We anticipate recovery to occur with the present resurgence of the disease as well.

Limber pine needle cast (*Lophodermella arcuata*) continued to be present on and bordering the Lewis and Clark National Forest, but like most of the other foliage diseases, it was not as severe as the previous year. This disease was prevalent in several local areas including the Belt Creek and Lick Creek drainages and around Black Butte, all in the Little Belt Mountains southeast of Great Falls.

Diseases of nurseries, ornamentals and tree improvement areas

1. Caragana with heart rot decay from shelterbelts in eastern Montana were infected with *Phellinus punctatus*. Affected stock was fairly young and the problem was common.

2. Container-grown Douglas-fir and lodgepole pine seedlings destined for planting in western Montana were extensively colonized with *Botrytis cinerea*. The fungus had developed during storage of seedlings over the winter and was discovered when boxes of seedlings were opened prior to spring planting.

3. Container-grown ponderosa pine were extensively infected with *Fusarium oxysporum* and other *Fusarium* spp. at the Montana State Nursery in Missoula. Seedlings exhibited typical root disease and cotyledon blight symptoms.

4. Western larch container-grown seedlings transplanted into an early selection trial at the Bigfork Tree Improve- ment Area (Flathead NF) showed top dieback symptoms during the spring of 1995. Isolations from roots of affected trees yielded *Fusarium* spp., particularly from plug roots. Root and soil samples failed to yield *Phytopthora*, which was suspected as being involved. Cause of the extensive dieback was unknown.

5. Container western larch being grown for a seed orchard displayed dieback and decline symptoms. Isolations from roots and container soil yielded unidentified *Phytophthora* from several of the trees. Source of infection was unknown.

6. Container-grown western larch seedlings at the Montana State Nursery in Missoula had extensive dieback and wilt symptoms. Potentially pathogenic organisms were not consistently isolated from diseased stock. The problem was likely due to extensive desiccation of seedlings located in outer rows because of uneven distribution of irrigation during the summer.

Common and Recurring Nursery Diseases

1. The most common and damaging diseases of conifer seedlings in Montana nurseries continued to be root diseases caused by *Fusarium* spp. These fungi caused damping-off, seed decay, and root diseases on many different conifer hosts in both bareroot and container nurseries. The most common soil-borne pathogen in bareroot nurseries was *F. oxysporum*, although several other species were commonly isolated from infected seed, soil and roots of diseased seedlings. The major pathogen in container nurseries was *F. proliferatum*, although *F. oxysporum* and several other *Fusarium* spp. also occurred at high levels in some nurseries. Fusarium diseases in nurseries were very difficult to control. Although all conifer species were susceptible, most damage occurred on Douglas-fir, western larch, ponderosa pine, western white pine, and Engelmann spruce.

2. *Cylindrocarpon destructans* caused severe losses to container-grown western white pine at several nurseries. Although damage occurred to other conifer species, root decay of five-needle pines was most serious and efforts to reduce damage were largely unsuccessful.

3. *Botrytis cinerea* was serious on several conifer species in container nurseries and on stock from storage. Western red cedar, western larch and Engelmann spruce were especially damaged.

4. Tip dieback caused by *Sirococcus strobilinus, Sphaeropsis sapinea*, and *Phoma eupyrena* commonly occurred at low levels at most bareroot nurseries. Ponderosa and lodgepole pine were the two most affected species.

5. Pythium root disease usually occurred at low levels at most bareroot nurseries. The most important causal organism was *P. Ultimum.*

OTHER FOREST CONDITION HIGHLIGHTS

Limber Pine Decline

Limber pine stands scattered across many locations on the Lewis and Clark NF have been significantly declining in health over the past few years. Large numbers of trees have very thin crowns plus branch flagging and poor terminal growth. Heavy mortality is occurring in some areas. Many of these stands were examined throughout the 1995 field season, and there appears to be no single definitive cause of the decline. Much of the defoliation is the result of limber pine needle cast. Aerial surveys have recorded localized patches of severe needle cast across the Lewis and Clark NF for the last 3 years. Blister rust does occur on the Lewis and Clark NF; however, the rust incidence is very low on limber pine in areas of concern and the disease is apparently not a factor in this decline scenario. There is evidence of damage from an unidentified shoot-feeding insect. Scattered individual trees have been killed by mountain pine beetle, and various secondary twig beetles have been found in some trees. Neither of these insects have been found to a great enough degree to be considered much of a factor. All examinations for root disease organisms have been negative. We hypothesize that the current condition of the limber pine is the result of a combination of several factors including the

defoliation from needle cast, severe climatic events, including a series of drought years and the late winter freeze of 1989, plus the inherent harshness of the sites where limber pine grows, and the age of the stands. We also wonder if perhaps the exclusion of fire in the limber pine ecosystems for the last several decades has somehow altered the soil nutrient/ moisture regimes. In 1996, the Forest Health Protection staff will assist the Lewis and Clark NF in developing a monitoring scheme that will track the defoliation of limber pine, quantify mortality, and identify specific causes of the decline.

Drought Related Tree Mortality

Consistently irregular mortality patterns due to drought began appearing around western Montana in the spring of 1995. The mortality was occurring mostly in smaller Douglas-fir trees, but small ponderosa pine and larger trees of both species were suffering the consequences of repeated droughty years. The larger trees were displaying various symptoms of drought stress such as top dieback, branch dieback and overall decline. The smaller Douglas-fir trees (less than 10 inches tall) were dying outright, while the smaller ponderosa pine trees were surviving with typical drought symptoms such as top dieback.

Service trips were requested from several areas in western Montana to investigate these mortality patterns. A trip to the east side of Flathead Lake revealed mortality and various drought symptoms in Douglas-fir and ponderosa pine. On the west side of Flathead Lake just north of Polson, is an area with continuing mortality. The ponderosa pine in this area are already stressed from repeated infections by *Elytroderma deformans* and *Diplodia pini*. Bark beetles, particularly *Ips*, kill a few of these trees every year, but many are now succumbing to the effects.

1995 SPECIAL PROJECTS

Bark Beetle Technology Development Projects

Testing the Effectiveness of a Combination of Bark Beetle Pheromones as Anti-attractants of the Pine Engraver (Ips pini [Say])

In 1993 and 1994, we tested the effectiveness of ipsenol (+50/-50) and verbenone (+86/-14) in preventing attacks by pine engravers in ponderosa pine slash. While encouraging, results were not as good as had been achieved in other experiments. Research recently completed in California suggested that various combinations of attractant pheromones of a competitor species, some of which are anti-attractants of the pine engraver, might prove more effective as anti-attractants of pine engraver than its anti-attractant pheromone alone.

In 1995, we initiated a study to investigate the properties of ipsenol, cis-verbenol, and (+)ipsdienol--the attractants of the California five-spined Ips (*Ips paraconfusus* Lanier)--as anti-attractants of the pine engraver (*Ips pini* [Say]). We used combinations of these semiochemicals, and the best anti-attractant combination we had previously tested--ipsenol and verbenone in a series of Lindgren funnel traps. Our intent was to test their effectiveness in masking the aggregative pheromones of the pine engraver--(-)ipsdienol and lanierone. In addition, we tested the effectiveness of 4-allylanisole (4-aa), a host terpene, as another anti-attractant.

A single trap constituted a "treatment." There were eight different treatments in the test and each treatment was replicated five times. Identical tests were conducted in western Montana and northern Idaho: One trap contained the pine engraver anti-attractant (ipsenol), the mountain pine beetle anti-attractant (verbenone), and the pine engraver attractant ((-)ipsdienol and lanierone),

- another contained the attractant of the California five-spined Ips (+)ipsdienol, ipsenol, and cis-verbenol) and the pine engraver attractant,

- a third contained two of three components of the California five-spined Ips attractant (ipsenol and cis-verbenol) and the pine engraver attractant,

- a fourth contained two of the other components of the competitor beetle (+ipsdienol and cis-verbenol) and the pine engraver attractant,

- a fifth contained the pine engraver attractant and liquid 4-aa as formulated by Dr. Jane Hayes,

- a sixth contained the pine engraver attractant, ipsenol, verbenone, and 4-aa (Hayes'),

- a seventh contained the pine engraver attractant and a gelled formulation of 4-aa (Phero Tech),

- and a final trap contained only the pine engraver beetle attractant--which served as a "control."

The study was installed in early April, prior to beetle flight. It was concluded after initial beetle flight was over--near the end of June.

Though unusually cool and wet spring weather resulted in less-than-anticipated numbers of beetles trapped; in the Idaho test we achieved an anticipated response to the pheromone combinations. Trapping results showed only 413 beetles were caught throughout the test period in Montana. Those did not lend themselves to analysis. In Idaho, more than 1,300 beetles were trapped--nearly half in the "control" traps.

An analysis of the Idaho data showed the "control" treatment (containing only pine engraver attractant) to be significantly different from any of the other treatments. The best anti-attractant treatment effect (though not statistically different from other anti-attractants) was the combination of ipsenol and verbenone. That is the treatment with which we had obtained best results in earlier tests, and the one proven most effective in similar tests conducted elsewhere. This combination will form the basis for a follow-up test in 1996 in which we will once again attempt to prevent engraver beetle attacks in ponderosa pine slash.

Evaluating the Optimal Dose of MCH for Protecting Standing Douglas-fir from Attack by Douglas-fir Beetle

In the second year of a 2-year test, we once again cooperated in a field experiment to test the optimal dosage of MCH, in bubble-capsule formulation, applied to stands at risk of infestation by DFB, in order to test the lowest effective dose needed to protect live trees. MCH was applied at rates of 50, 100, and 150 bubble capsules per hectare in 1994. Those treatments were sufficiently effective that we tested the lower end of the scale in 1995. In 1995, we applied 15, 30, and 50 bubble capsules per hectare. Untreated plots served as controls.

We installed two "blocks" of the test--a block being comprised of four, 1-hectare plots, located no closer than 200 meters to any other plot. Three additional blocks were installed in eastern Oregon, two in southern Utah, and one in southern Idaho. A "plot" was a 1-hectare, circular plot of predominantly large-diameter Douglas-fir, susceptible to DFB. We chose areas close to known beetle infestations, but there could be no currently infested trees on the plot. At each plot center, we hung three Lindgren funnel traps, baited with DFB pheromone attractants. On the plot's perimeter, we stapled MCH bubble capsules to standing trees. Spacing of bubble caps was determined by treatment. The four treatments were 0, 15, 30 and 50 bubble caps per plot. Treatments within the block were randomly assigned. Plots were installed in early April and monitored weekly. Treatment evaluation was conducted following beetle flight. Our evaluation was conducted in early August.

Results showed 50 bubble capsules per hectare to be an effective treatment in protecting live Douglas-fir from attack by DFB. Results of the 2-year test are a part of the package submitted to EPA seeking registration of MCH. When registration is finally granted, MCH should become a very effective tool in the management of stands threatened by DFB.

Douglas-fir Beetle Risk Rating

This was another multi-Region, 2-year project in which we became involved in 1994. Data collection was completed in 1995. Coordinated and led by Bill Schaupp (R-2) and Jose Negron (RM Station), the objective of this project is the development of a "loss prediction (risk-rating) model" for stands infested or threatened by DFB. Over the 2 years, we collected data from areas previously infested by DFB--gathering as much site and stand data as could be reasonably measured by a two-person crew using basic stand-exam procedures. Analyses are now being performed to determine which site and/or stand factors are most correlated with mortality caused by DFB, and how those factors may help assess potential mortality during an outbreak.

During two field seasons, and covering infested areas in Colorado, Idaho, Utah, Wyoming and Montana, data has been collected on more that 700 plots. We gathered data on about 120 plots in Montana and north Idaho alone. Data analysis, begun following the 1994 field season, is continuing. We hope that a model, to help predict tree mortality attributable to DFB, thereby becoming a significant management tool, will be available to the land manager within the next year or two.

Insects Affecting the Reproduction of Whitebark Pine in the Western United States

During 1995, Sandy Kegley and Nancy Campbell, in cooperation with other western entomologists in Regions 4, 5 and 6, initiated a study to examine the insect complex affecting the reproduction of whitebark pine. Seven sites in the western United States were chosen with three sites in Idaho and one in Montana. The sites in Idaho are (1) on Gisborne Mountain outside of Priest River, (2) near Seven Devils lookout tower outside of Riggins, and (3) on Snowbank Mountain outside of Cascade. The site in Montana in near Daisy Pass outside of Cooke City.

Fourteen treatments, which consisted of excluding insects with mesh bags at different times during the 2-year cone development cycle, were replicated on each of 15 trees at each site. Mature cones will be collected at the end of 1996 to identify the insect complex and the damage they cause.

A preliminary study in 1994 showed that between 50-100 percent of cones collected were infested with the coneworm, *Dioryctria abietivorella*. During an examination of cones, flowers and pollen in 1995, we found six different insects feeding in or on reproductive structures. We have not yet determined their impact on seed production or viability.

Results of this study will help develop management strategies to reduce the impact of insects on whitebark pine.

Western Spruce Budworm Permanent Plots

Permanent plots on the Beaverhead, Bitteroot, Deerlodge, Lewis & Clark, Lolo, Helena and Nez Perce NFs were re-measured for defoliation and budworm population estimates. No new plots were established during 1995.

Light defoliation was seen on individual plots on the Helena and Beaverhead NFs. No defoliation was detected in any of the other stands.

All budworm permanent plots will be monitored annually for defoliation and damage over the long term for budworm effects on ecosystem structure and function and for model validation.

TRAINING

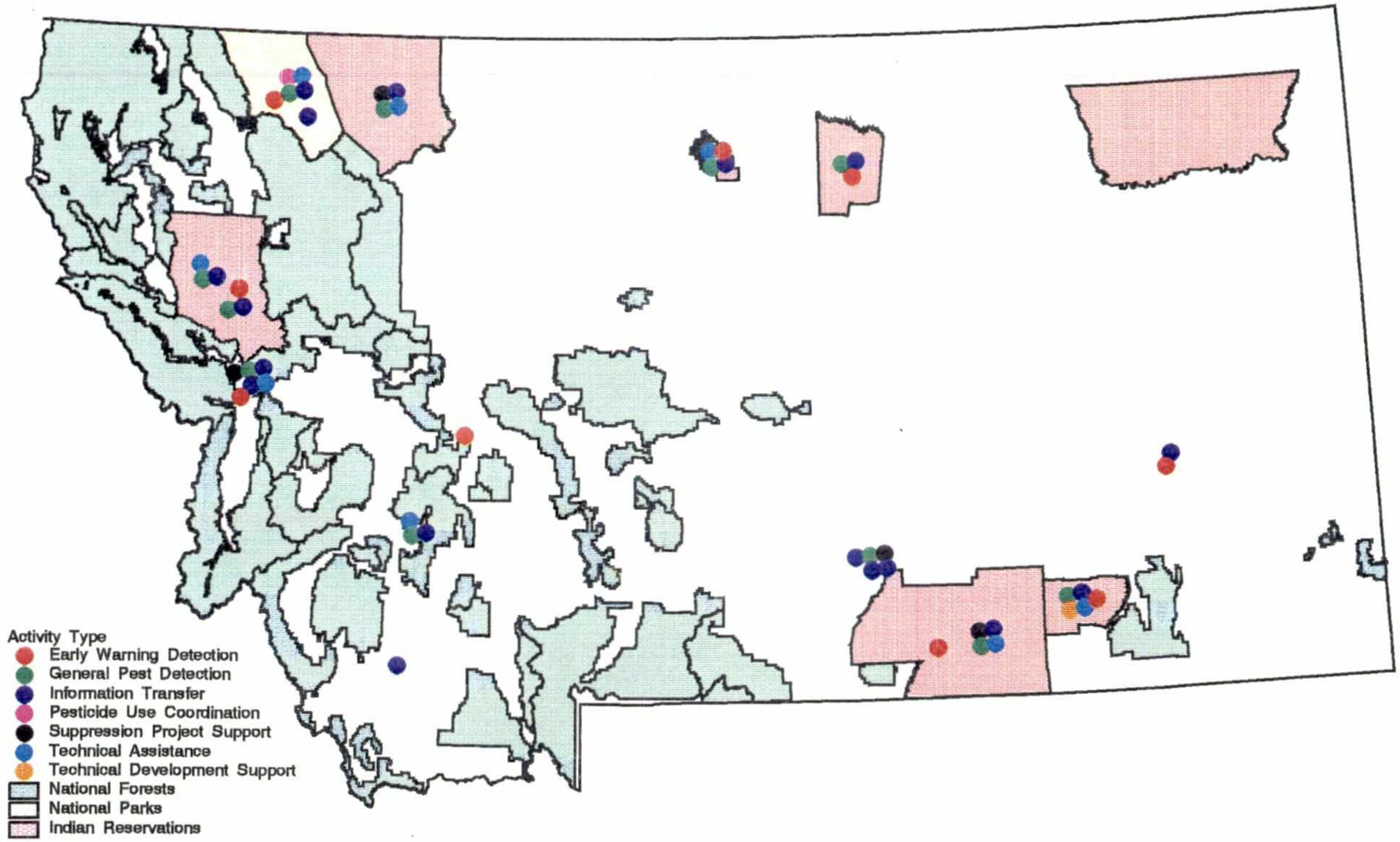
Insect and Disease Training

Three insect and disease training courses were offered in Montana in 1995 through a cooperative effort between Forest Health Protection and the Montana Department of Natural Resources. Two sessions (June 4-5 and June 6-7) focused on basic identification of important forest insects and diseases common in the State, and recognition of damage they cause.

The other session (September 24-26) emphasized management of insects and diseases in forested ecosystems. These courses were offered free of charge to anyone interested in natural resource management including foresters and other specialists with government agencies or industry and private

landowners. A total of 85 people took part in these training sessions in 1995. For more information on these annual courses, contact the USDA Forest Service, Forest Health Protection Field Office in Missoula.

Forest Health Protection
Assistance to Other Federal Land Managers



APPENDIX

FOREST HEALTH PROTECTION PERSONNEL

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Nancy Campbell	Entomologist	3281
Ken Gibson	Entomologist	3278
Carma Gilligan	Bio. Science Tech.	3130
Blakey Lockman	Plant Pathologist	3189
Tim McConnell	Bio. Science Tech., Aerial Survey	3136
Larry Stipe	Entomologist, GIS Coordinator	3289
Jane Taylor	Plant Pathologist	3463
Sue Hagle*	Plant Pathologist	

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COMMON AND SCIENTIFIC NAMES

Diseases

Annosus root disease	*Heterobasidion annosum* (FR.) Bref.	Primary hosts: DF, GF, PP, SAF
Armillaria root disease	*Armillaria ostoyae* (Romagn.) *Herink*	DF, GF, SAF, sapling pines
Atropellis canker	*Atropellis piniphila* (Weir) Lohn. and Cash	LPP
Brown cubical butt rot	*Phaeolus schweinitzii* (Fr.) Pat.	DF
Comandra rust	*Cronartium comandra* Peck.	LPP, PP
Diplodia blight	*Sphaeroposis sapinea* (Fr.) Dyko.	PP
Dutch elm disease	*Ceratocystis ulmi* (Buism.)	American elm
Dwarf mistletoes	*Arceuthobium* spp.	LPP, DF, WL
Brown stirngy rot	*Echinodontium tinctorium*	GF, WH
Elytroderma needle cast	*Elytroderma deformans* (Weir) Darker	PP
Fusarium root rot	*Fusarium oxysporum* Schlect.	DF (Nursey)
Grey mold	*Botrytis cinerea* Pers. Ex Fr.	WL (Nursery)
Larch needle blight	*Hypodermella laricis* Tub.	WL
Larch needle cast	*Meria laricis* Vuill.	WL
Laminated root rot	*Phellinus weirii* (Murr.) Gilb.	DF, GF, WH, SAF
Lodgepole pine needle cast	*Lophodermella concolor* (Dear.) Dark	LPP
Pini rot	*Phellinus pini* (Thore:Fr.) Pilet.	DF, WL, ES, All pines
Sirococcus tip blight	*Sirococcus strobilinus* Preuss	WWP (Nursery)
Swisse needle cast	*Phaeoeryptopus gaeumannii* (Rhode)	DF
Western gall rust	*Endocronartium harknessii* (Moore) Hirta.	LPP, PP
White pine blister rust	*Cronartium ribicola* Fisch.	WWP, WBP
Rhabdocline needle cast	*Rhabdocline pseudotsugae* Syd.	DF

Insects

Douglas-fir beetle	*Dendroctonus pseudotsugae* Hopkins	DF
Douglas-fir tussock moth	*Orygia pseudotsugata* (McDunnough)	DF, TF, ES
Gyopsy moth	*Lymantria dispar* (Linnaeus)	Most hardwoods
Mountain pine beetle	*Dendroctonus ponderosae* Hopkins	all pines
Pine engraver beetle	*Ips pini* (Say)	PP, LPP
Spruce beetle	*Dendroctonus rufipennis* (Kirby)	ES
Western balsam bark beetle	*Dryocoetes confusis* Swaine	SAF
Western spruce budworm	*Choristoneura occidentalis* Freeman	DF, TF, ES, WI
Western pine beetle	*Dendroctonus brevicomis* LeConte	PP
Fir engraver beetle	*Scolytis ventralis* LeConte	GF, SAF
Lodgepole terminal weevil	*Pissodes terminalis* Hopping	LPP
Balsam woolly adelgis	*Adelges piceae* (Ratzeburg)	SAF, GF
Pine tussock moth	*Dasychira plagiata*	PP
Sawflies	*Neodiprion autumnalis*	PP
Tip moth	*Rhyacionia* species	PP

DF = Douglas-fir; GF = Grand fir; TF = True fir; SAF = Subalpine fir; PP = Ponderosa pine; LPP = Lodgepole pine; WWP = Western white pine; ES = Engelmann spruce; WH = Western hemlock; WL = Western larch; MH = Most hardwoods; WRC = Western redcedar; WBP = Whitebark pine

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